IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 20, Issue 10 Ser.6 (October. 2021), PP 16-22
www.iosrjournals.org

Prevalence of Cusp of Carebelli in the Permanent Maxillary First Molar in the School Children of North Ratnagiri District.

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Abstract:
Introduction: *Cusp of Carebelli is an extra tubercle on mesiopalatal surface of permanent maxillary first molar tooth. Etiology of the same is unknown, can be regarded as the combination of genetic and exogenous factors which are responsible for its development. As one of the etiologies is genetic, it is found to be an inherited characteristic. The distribution of Carebelli's trait is highly variable among individuals at different places.*
Aim: *The aim of this study conducted is to determine the presence, occurrence, morphology of the cusp of carebelli, its clinical significance and to check and compare prevalence between males and females.*
Materials & Methods: *The descriptive study was conducted on the sample size of 666 individuals from three schools of talukas viz. Khed, Mandangad and Dapoli of North Ratnagiri District. The data collected was analyzed using the statistical package SPSS version 20.0 (Chi square test).*
Results: *There was no statistical difference between male and female regarding presence of cusp of carabelli. Gender-wise there was statistically significant difference between morphology of cusp of carabelli (p=0.042). Khed taluka had the highest prevalence of occurrence of cusp of Carebelli (Total =156).*
Keywords: *Cusp of carebelli, human dentition, morphologic variation, North Ratnagiri district.*

Date of Submission: 04-10-2021 Date of Acceptance: 18-10-2021

I. Introduction:

The principal basis of the dental identification lies in the fact that no two dentitions are alike and the teeth are unique to an individual. The dental characteristics such as the shovelling or scooping of the upper incisor (most common in Asiatic Mongoloids and American Indians), taurodontism, chisel shaped incisors, Carabelli's cusp, hypocone, and protostylid, peg shaping of the teeth can be used to determine the ethnicity of the individual. Developmental variations of teeth like anomalies of number, size and shape are frequently observed during a routine dental examination.

One such developmental variation is presence of accessory cusps on the teeth.[cc5] The variations in tooth morphology have been studied since the early 1800s. The Cusp of Carabelli is one of the most commonly occurring variations in tooth structure and has been widely investigated in the permanent as well as the primary dentition. In 1842, an Australian dentist, Georg Carabelli, first described and used the term 'Cusp of Carabelli' or 'Carabelli's trait'. However, its existence was described earlier by Rousseau in 1827.[cc1] The cusp of carebelli is a small additional cusp at the mesiopalatal line angle of maxillary first molar. It is the fifth cusp separated from mesiopalatal cusp by grooves known as carebelli groove.

Human dentition is constantly changing in its size, form, number these characters are excellent modes for studying human variation. Talon's cusp originates during morphodiffferentiation stage of tooth development. This is a heritable feature; it may be entirely absent or present in various forms. It has been also proposed that homozygosity of gene is responsible for pronounced tubercle, whereas heterozygosity shows small grooves and pits. Accessory tooth cusps are quite helpful in anthropological and phylogenetic analysis. They help in understanding the genetic variance and relationships among different races and ethnic populations.

The study of accessory cusp helps in population studies and their characterization sheds light on the interbreeding trends or history among the populations. Genetic as well as external factors can play significant role in development of dentitions although studies have shown that genes play a more dominant role in their presence.[cc5] The purpose of this study is to determine the prevalence and degree of expression of carebelli trait in permanent maxillary first molar in selected population of North Ratnagiri district.

II. Materials:

Study design:
The present study was a descriptive study conducted to determine the presence, occurrence, morphology of the cusp of carebelli, it's clinical significance and to check and compare prevalence among students of age group between 14 to 18 years of the 3 selected schools from the North Ratnagiri district.

Study Duration:
The study was conducted from June 2018- September 2018 (3 Months)

Source of data/ Study location:
Three schools were selected from the North Ratnagiri district (one school from each taluka) to obtain the sample for data collection by simple random sampling. To ensure randomness and to avoid bias lottery method was adopted. Data was collected from students aged 14-18 years of,
1. Shriman Chandulal Seth high school, Khed, Ratnagiri, Maharashtra.
2. A. G high school, Dapoli, Ratnagiri, Maharashtra.
3. National high school, Mandangad, Ratnagiri, Maharashtra.

III. Methodology:

The following procedure was adapted to carry out the present study:
1. Obtaining ethical clearance.
2. Permission from the authority.
3. Study setting
4. Sample size derivation.
5. Inclusion criteria.
6. Exclusion criteria.
7. Content validation of the questionnaires.
8. Scheduling the study
- Informed consent.
- Study design

9. Statistical analysis

Ethical clearance:
Prior to the start of the study, a protocol of the intended study was submitted to the Institutional Review Board, Yogita Dental College & Hospital, Khed and ethical clearance for the present study was obtained.

Permission:
Permission was obtained from the principals of respective three schools.
1. Shriman Chandulal Seth High school, Khed, Ratnagiri, Maharashtra
2. A. G high school, Dapoli, Ratnagiri, Maharashtra
3. National high school, Mandangad, Ratnagiri, Maharashtra

Sample size estimation:
Estimated using the formula
N= Z2(1-□) x PQ
□2
Z(1-□)=1.65 (For 90% Confidence Interval) - Sample size= 660

Inclusion criteria:
1. Only fully erupted maxillary molars were included.
2. 16, 26 maxillary molars should be present and intact.

Exclusion criteria:
1. The grossly destructed teeth,
2. Unilateral missing first molar,
3. Anomalous teeth,
4. Teeth with prostheses and orthodontic cases

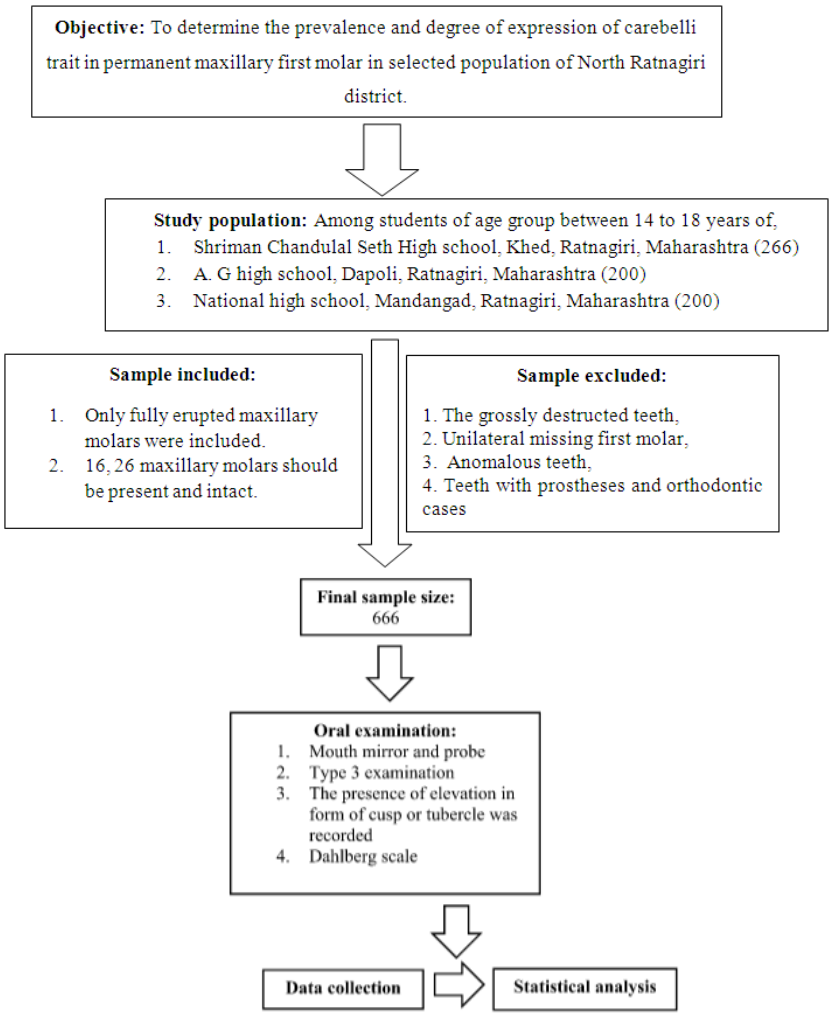
Instruments used:
1. Mouth mirror
2. Straight probe
3. Dahlberg scale to examine the cusp, based on its size.

Scheduling the study:
a) Informed consent
Written informed consent was obtained from the participants after explaining the nature of the study. The Performa consisted of information about the study, the option for the subject to withdraw from the study and about the voluntary participation of the study subjects.

b) Participant selection
The present study was conducted among students of age group between 14 to 18 years of
1. Shriman Chandulal Seth High school, Khed, Ratnagiri, Maharashtra (n=266)
2. A. G high school, Dapoli, Ratnagiri, Maharashtra (n=200)
3. National high school, Mandangad, Ratnagiri, Maharashtra (n=200)

Study design:
This was a descriptive study conducted on the basis of following points,
a) Oral examination was performed using aseptic instruments that is using Mouth mirror and probe under proper illumination.
b) The subjects fulfilling the inclusion criteria were examined by type 3 examination and occurrence of cusp of carebelli was recorded.
c)The presence of elevation in form of cusp or tubercle was recorded as present, whereas smooth palatal surface was regarded as absent.
d) Examiners were instructed for proper recording. The inter and intra examiner reproducibility were calculated and was found almost perfect agreement score. This was done to avoid bias due to multiple examiners.
e) Dahlberg scale was used to examine the cusp, based on its size. The prevalence was calculated as percentage values.

Statistical analysis:
The statistical procedures were carried out in 2 steps –
1. Data compilation and presentation: The data obtained was compiled systematically, transformed from pre-coded pro-forma to a computer and master table was prepared in the Microsoft excel, 2007.
2. Statistical analysis: The data collected was analyzed using the statistical package SPSS version 20.0 and Chi square test.



IV. Results:

In this study total of 666 subjects of age group 14 to 18 years were screened, out of which 338 were males and 328 were females. The occurrence of this trait was found in 116 males and 103 females, though higher were in male there was statistically insignificant difference with p=0.423. The accessory cusp was examined for its presence unilaterally and bilaterally, it was unilaterally present in 14 males and 12 female subjects, and whereas its bilateral presence was noted in 102 males and 91 females. Furthermore, adding to its specific morphology, it was observed as prominent cusp in 111 males and 101 females, and was observed as tubercle only in 5 males 2 females. There was significant difference among male for occurrence (unilateral/bilateral) with p=0.032 with higher number for bilateral. Similarly, it was for female with p=0.038 (Table 2). There was statistically significant value for occurrence of tubercle and prominent cusp in each gender with p<0.001 (Table 3).

Adding to the details of each taluka, 266 subjects were screened in the Khed taluka out of which, the trait was expressed in 159 subjects. In these 159 subjects, the cusp was unilaterally present in 14 individuals, whereas bilaterally in 145 individuals. In Dapoli and Mandangad taluka 200 subjects were examined in each, the trait was observed for its presence in 24 subjects in the former and 36 in the later. In the taluka of Dapoli the cusp was unilaterally observed in 5 subjects and bilaterally in 19 subjects, whereas in the taluka of Mandangad, the prevalence of trait unilaterally and bilaterally was 7 and 29 respectively. Taluka wise frequency distribution of the morphology is tabulated in (Table 4).

Table 1: Gender-wise Prevalence of Cusp of Carebelli. (Chi- Square Test)

Gender	Present	Absent	p Value Chi Square Test
Males (338) (50.75%)	116 (34.31%)	222 (65.69%)	**0.423**
Females (328) (49.25%)	103 (31.40%)	225 (68.6%)	
Total (666)	219	247	

*Statistically Significant

Graph 1: Gender-wise Prevalence of Cusp of Carebelli.

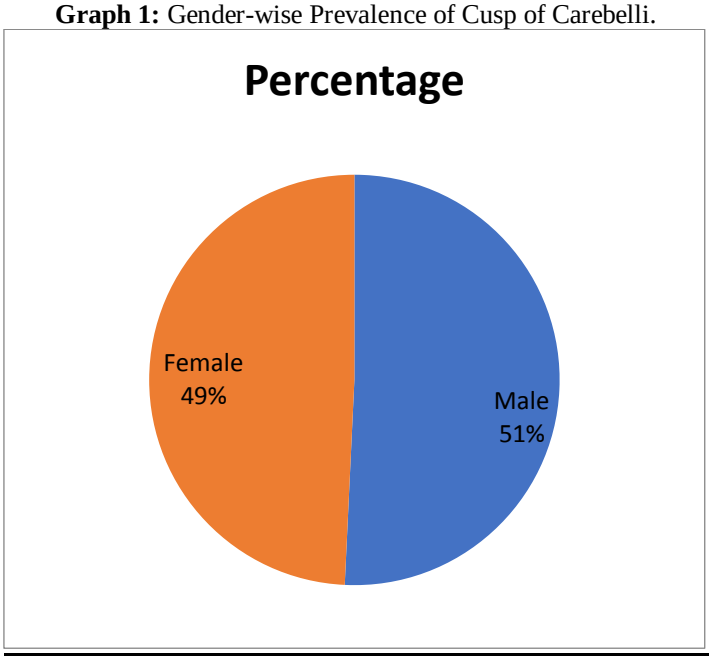


Table 2: Gender-wise Prevalence of Cusp of Carebelli (Unilateral/Bilateral)

Gender	Unilateral	Bilateral	p Value Chi Square Test
Males (116)	14 (12.06%)	102 (87.93%)	**0.032***
Females (103)	12 (11.65%)	91 (88.34%)	**0.038***
Total (219)	26	247	**0.042***

*Statistically Significant

Graph 2: Gender-wise Prevalence of Cusp of Carebelli (Unilateral/Bilateral)

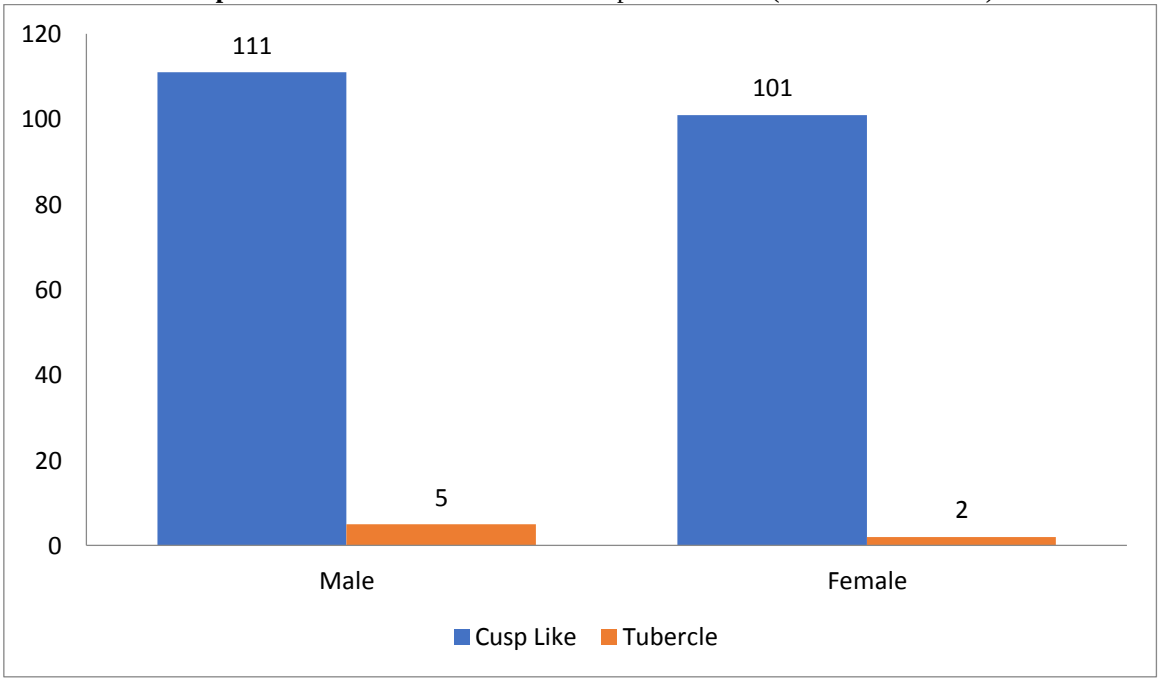


Table 3: Prevalence of Cusp of Carebelli based on Morphology (Cusp Like/Tubercle)

Gender	Cusp Like	Tubercle	p Value Chi Square Test
Males (116)	111 (95.88%)	5 (4.31%)	**<0.001***
Females (103)	101 (98.05%)	2 (1.94%)	**<0.001***
Total (219)	212	07	**<0.001***

*Statistically Significant

Graph 3: Prevalence of Cusp of Carebelli based on Morphology (Cusp Like/Tubercle)

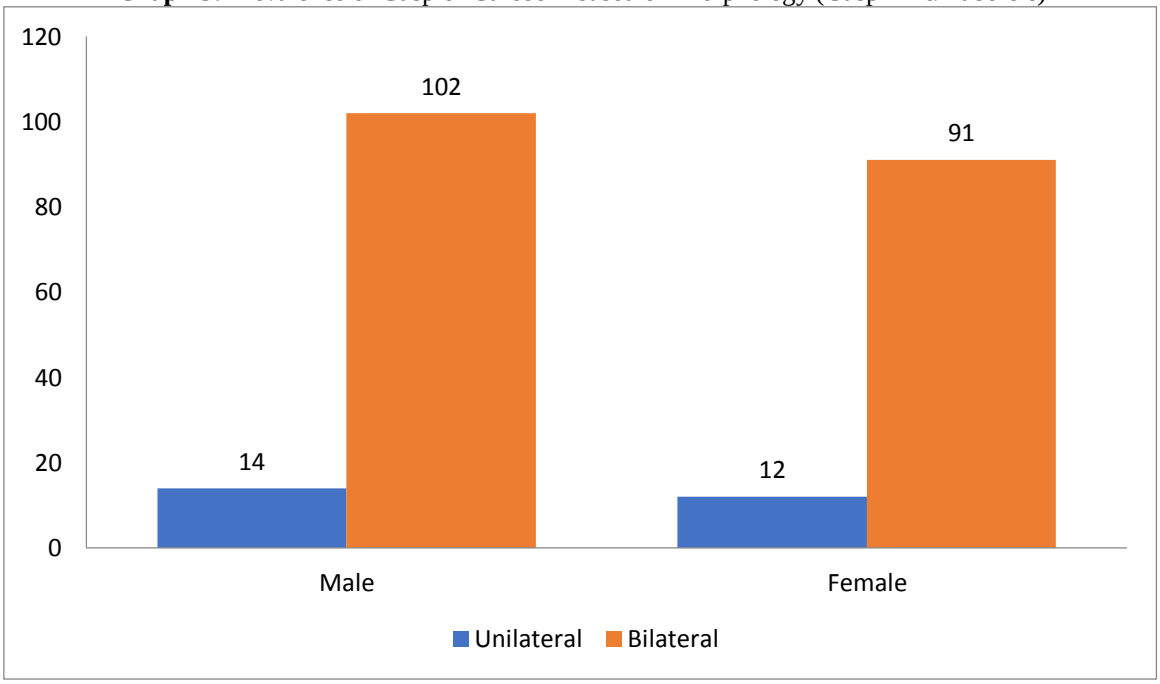


Table 4: Taluka-wise Prevalence of Cusp of Carebelli.

Dapoli	Cusp like	22
	Tubercle	2
	Total	24

	Missing	176
	Total	200
Mandangad	Cusp like	**34**
	Tubercle	2
	Total	36
	Missing	164
	Total	200
Khed	Cusp like	**156**
	Tubercle	3
	Total	159
	Missing	107
	Total	266

V. Discussion:

The study of dental morphological characteristics and odontometry is important in anthropological research since it can provide information on the phylogenetic relationship between species, as well as variations and diversities within a population[cc20]. The study of morphological variations of teeth is important from anthropological and forensic point of view. Carebelli trait has always been a fascinating morphological trait for dentist, geneticists, anthropologist, as enamel is the hardest tissue of body teeth preserve than any other human remains; hence continuity between living and ancestral populations can be establishing mere easily by dentition also help in establishing phylogenetic relationship between closely related populations. It is commonly accepted that dental characteristics, such as size, shape, presence, number of cusps, and also the size of the dental arches, are genetically determined[cc20]. For this reason, the characteristic trait differs among races and species and can constantly alter due to natural selection and genetic changes[cc20]. The most commonly detected dental characteristic is the Carabelli cusp. This can be used to determine the degree of intercourse between populations with different racial characteristics[cc23]. This trait is studied equally for its clinical dentistry significance in the field of endodontic and orthodontic. In the present study this character was almost equally seen in both males and females but a slight shift if 2.91% towards males is seen, suggestive to their complex crown morphology and almost 96.86% it was observed as a prominent cusp and more often seen bilaterally. Dental characteristics can be divided into the so-called 'western' and 'eastern' types[cc20,24,25]. The frequency of a Carabelli cusp is high in Europeans, 70–90 per cent, but low in oriental races[cc20]. Prevalence of cusp of carebelli in this study was 32.88% these findings were in agreement with other similar studies listed below,

1. Pakistan Khyber College of dentistry out of 400 individual's traits was expressed in 119 individuals (29.7%).[cc26]
2. According to study conducted on South Indian population out of 60 subject's traits was expressed by 23 (38.33%) subjects.[cc27]
3. Study conducted on Nepalese population showed that the trait was expressed in 205 (68.3%) people out of 300 studies.[cc12]
4. On basis of study conducted in university of Suleimani showed presence of trait in 45(30%) population out of the selected sample size of 150.[cc3]

These morphological anomalies have great significance, both orally and anthropologically. The anatomy of the teeth can provide information on a population and as they are not often influenced by time, they can be studied on skeletons, and the development and changes of a population can be followed. The morphology and prevalence of Carabelli cusps can provide answers to many questions, such as division of a population into western or oriental type dentition, the mixture of races within a population, and the homogeneity of European and oriental populations. A Carabelli cusp is more common in Europeans than Mongoloids.[cc20]

VI. Clinical Significance:

The morphology of tooth structure is important in clinical dentistry for dental materials manufacturing industries. The prefabricated molar brands commonly used by orthodontist have no accommodation for this additional cusp hence results in loose fit. As a result, the space is filled with food debris, bacteria resulting in early caries and periodontal disease. This cusp hence must be considered during pit and tissue sealing, also in consideration of extraction forceps have no place for accommodation of cusp of carebelli which may lead to tooth fracture.

VII. Conclusion:

The cusp of carebelli has got attention in scientific fields like anthropology genetics and evolution. It is often overlooked variant hence more studies must be conducted considering its clinical significance. The prevalence of cusp of carebelli is variable in different regions and races in the world. In this study attempt was made to determine its prevalence in group hailing in North Ratnagiri district. Most common form observed was a small tubercle present bilaterally and also there is no sex predilection of this trait.

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